

THURSDAY, MARCH 6, 1879

COAL AND COAL-MINES

A Treatise on Coal, Mine-Gases, and Ventilation. By J. W. Thomas. (London: Longmans, 1878.)

MR. THOMAS is known to chemists by reason of the numerous and excellent analyses of the gases inclosed in various coals which he published some time ago in the *Journal* of the Chemical Society. Marsilly in France, and Meyer in Germany, first broke ground on this subject, but it is to Mr. Thomas, who very greatly improved the method of research, that we owe our most exact knowledge of the character of these occluded gases. The matter is of considerable importance from a twofold aspect. It not only serves to throw light upon the scientific question of the formation of coal, but also affords us information on the very practical question of the nature of the influence of the atmosphere upon the deterioration of coal. These observations attracted sufficient attention from mining engineers and persons connected with mining to induce the author to reprint them together with other matter relating to the general subject, and the result is the volume before us—a work which it is not too much to say ought to be in the hands of the manager and sub-officers of every colliery in the kingdom. Although the subjects of gases in coal and of the deterioration of coal by atmospheric influences are treated at considerable length, the relative or connected matter occupies by far the greater portion of the book, and we have chapters on the Diffusion and Transpiration of Gases, Explosions in Mines and Ships, Combustion, Ventilation, &c.

The opening chapter is occupied by a discussion of that most vexed of questions, What is Coal?—a question which has already cost some people much patience and more money to get answered, but hitherto without success. We are bound to say our author does not help us towards a solution; we are apparently as far off as ever from a scientific definition of this everyday commodity. His remarks on the classification of coals are extremely just. It is not surprising, from the author's connection with the South Wales Basin, that the particular subject of anthracite should receive special attention at his hands. The origin of this form of mineral fuel has given rise to much discussion in the past, but it is only within recent time that the opinion that it is not necessarily the oldest transition-product in the decay or alteration of vegetable matter has begun to gain ground. Our author throws considerable light on the process which has been at work in the formation of anthracite, from a study of the composition of the gases which are found inclosed in this class of coal. He regards the process of the formation of coal (after the first or primary decomposition which ensued during the time the vegetable matter was in the act of being buried) to have taken place in four ways, viz. :—

1. The dry process aided by heat, leading to the production of anthracite.
2. The dry process without much abnormal heat, to which the production of steam coal and Wigan cannel is due.
3. The wet process with heat, to which may belong

the production of Scotch cannel and the more dense varieties of bituminous or house coals.

4. The wet process without long-continued heat, to which we may assign the formation of ordinary bituminous (house coals) and lignite.

With respect to the nature of the material from which coal has been originally derived, Mr. Thomas has little or nothing to add to what is commonly stated in popular works on the subject. To dismiss the spore-theory in some six or eight lines, with the assertion that "there is little evidence of a weighty character to confirm this hypothesis," is, in the light of existing facts, scarcely just to the researches of Carruthers, Morris, and Huxley. To say that all coal has been derived from lepidodendroid spores would unquestionably be incorrect, but to assert that many coals have been largely derived from such material is undoubtedly true. This much, we suppose by this time, is conceded by the majority of authorities on the subject: the difference between them is rather as to the proportionate part played by the spores.

As regards the character of the gas occluded in coal, this depends not merely upon the structure of the coal, but upon the conditions under which its formation has occurred and the depth below the surface at which it is situated. On the whole Mr. Thomas's analytical results agree fairly well with those of Dr. Meyer, in spite of the somewhat faulty method adopted by the latter; but the inferences which the two experimenters draw from their observations are not unfrequently opposed. There seems to be a decided difference between the gas inclosed in lignites and that found in coals of the older formations. Zitowitsch first detected carbonic oxide in some specimens of Bohemian lignites, and the author has detected the same gas in appreciable quantity in the well-known lignites of Bovey Heathfield, in Devonshire. On the other hand, no coal of the carboniferous period has been found to contain this gas. Another characteristic difference between the coals of the carboniferous and tertiary periods is seen in the absence of all hydrocarbons among the gases occluded in the latter varieties.

The presence of carbonic oxide in "after-damp" has been frequently surmised, but Mr. Thomas brings direct evidence to prove the fact. Until quite recently it was the general belief among chemists that when marsh-gas—the "fire-damp" of the miners—is mixed with less air than is required for complete combustion, only as much of the hydrocarbon is burnt as the oxygen present can convert into carbon dioxide and water. It is now found that when marsh-gas is exploded with a quantity of oxygen or air insufficient for complete combustion, the whole of the marsh-gas disappears into carbonic oxide, carbon dioxide, water, and free hydrogen. The importance of this observation is obvious. It has not unfrequently happened that after an explosion the expressions of the countenances of the victims, who have been found sitting or leaning in the most natural positions, have worn no trace of fear or intense anxiety, such as we should suppose would come upon them amidst the roar and wreck of the disaster. These men have not been asphyxiated by carbonic acid or drowned in excess of nitrogen: they have been struck down by the infinitely more deadly carbonic oxide. Instances too have occurred in which the explorers after an explosion have been almost as suddenly

overwhelmed, even when their lamps were burning freely. These facts point to an entirely different mode of treating those who have been rescued and who are still suffering from the effects of after-damp, from that which has been hitherto adopted. It is not too much to say that many a life could have been saved if, acting on Hoppe-Seyler's observations, artificial respiration could have been maintained for some time after apparent death.

There is much in this book that we should have liked to have dwelt upon had space permitted, for almost on every page we discern evidences of originality and freshness such as might be expected from one who, as we have seen, has brought the researching spirit to bear upon his subject. Whilst chemists are wearying themselves and others with vain speculations as to bonds and atomic-groupings, far too many of the common matters of everyday life are thrown aside as unfruitful or worked out. No one, however, could take up this book and not see that in the matter upon which it treats there are fifty problems waiting for solution—some of them most pressing in the interests of humanity, and any one of them capable of yielding a rich harvest of facts. T. E. THORPE

THE MORPHOLOGY OF THE ECHINODERMS

Morphologische Studien an Echinodermen. Von Dr. Phil. Hubert Ludwig, Director der naturwissenschaftlichen Sammlungen in Bremen. 1 Band mit 23 Tafeln und 5 Holzschnitten. (Leipzig: Verlag von Wilhelm Engelmann, 1877-79.)

WITHIN the last three years very numerous researches have been made on that most interesting group, the Echinoderms, to which, we are glad to see, the rank of a distinct sub-kingdom is now generally assigned. Greeff, Götte, Lange, Ludwig, Simroth, and Teuscher, in Germany; Perrier in France, Théel and Lovén in Sweden, Agassiz, Lyman, and Pourtalès in America; and in our own country Sir Wyville Thomson, Duncan, Sladen, and the two Carpenters, father and son, have each contributed more or less to our knowledge of the morphology and physiology of the group.

Of the many observations made and recorded by the above-mentioned naturalists, those of Dr. Ludwig ("Ei-bildung Ludwig," as we have heard him called by embryologists) seem to us to be among the most important, alike from their variety, and, as we are strongly inclined to believe, from their general accuracy. We are not so sure, however, that all Dr. Ludwig's conclusions are as correct and reliable as his observations are trustworthy, for there are certain points on which we have very strong grounds for dissenting from his views.

The volume before us, representing the result of three years' work, mostly microscopic, is the first of a promised series of studies in Echinoderm morphology, and consists principally of memoirs on the anatomy of Crinoids and Starfishes.

It contains much that is new, or rather that was so when the individual memoirs were first published in the *Zeitschrift für wissenschaftliche Zoologie*, and much that is to be found, stated more or less correctly in the writings of other workers, both before Ludwig and contemporaneous with him.

The first paper in the series, forming about one-third

of the whole volume, is devoted to the anatomy of Comatula. While generally confirming Dr. Carpenter's results, respecting the canals of the arms and the chambered organ, Ludwig (whose observations on this type were contemporaneous with those of four other observers, two in Germany and two in this country) publishes several new and interesting anatomical details.

Among the most important of these is the presence of blood-spaces around the genital organs, and also of a system of blood-canals ventral to the water-vascular system. Both of these systems probably communicate with the vascular "axial prolongation" of Dr. Carpenter, which runs up into the disc from the chambered organ situated in the calyx, and represents the "heart" of the Starfishes.

Ventral to the radial blood-canal is the fibrillar sub-epithelial band, to which Dr. Ludwig assigns a nervous character from its resemblance to a similar and similarly placed structure, that is generally, though not universally, supposed to be the nerve of the arm of a Starfish.

Ludwig's views have been completely adopted by Gegenbaur, in spite of the fact that this band is absent from half, or sometimes from more than half, the arms of many Comatulæ. We scarcely think that Ludwig has taken this fact sufficiently into consideration in his discussion of Dr. Carpenter's suggestion that the axial cords of the skeleton constitute the chief nervous system of Comatula; and we are not altogether satisfied with the purely diagrammatic manner in which he figures this axial cord, and with the meagre description which he gives of it. He makes no mention whatever of the regular manner in which it gives off branching bundles of fibres to the muscles and other structures in the middle of every arm-joint, except [in quoting their discovery by others, though he cannot well have helped seeing them, and he does not deny their existence. At the same time he seems inclined to admit the probative force of Dr. Carpenter's experiments at Naples, which tend to show that these axial cords are the *motor* nerves, at any rate of the complex Crinoid organisation, permeated though they may be by a coagulable fluid. Should this view be the true one, it is another argument in favour of Leuckart's separation of the Crinoids and their allies from the other Echinoderms, to form a distinct class, the *Pelmatozoa*.

Until lately the Crinoids have not been credited with an ambulacral system homologous with that of the other Echinoderms. Götte, however, has shown that, as far as development is concerned, this is not the case, and the true water-vascular ring of the adult Comatula was first described by Ludwig, though its radial branches in the arms have long been known. Depending from it into the coelom are numerous small tubules which Ludwig describes as open at the ends, and compares to the sand-canals of the other Echinoderms, more especially of the *Holothurians*.

After finishing his researches on the anatomy of Comatula, Ludwig turned his attention to Rhizocrinus, and found that it corresponds with Comatula in all essential points of structure. This was the first-stalked Crinoid in which the presence of a chambered organ was determined. It has since been found in *Pentacrinus* and *Bathycrinus*, and Ludwig's discovery that its chambers are continued down the axis of the stem as five blood